



**Enhanced  
Voice  
Services  
Patent  
Landscape**





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# INTRODUCTION

The need to pay royalties for patents declared as essential to the standards utilized in mobile devices is part of the cost of doing business for device makers. Generally, device makers can expect to pay approximately 8% of the wholesale price of a smartphone to satisfy the aggregate royalty burden for the relevant 3GPP standards. However, some holders of a relatively small subset of patents declared as essential to the standards [Standard-Essential Patents, or “SEPs”] are seeking royalties many times higher than the estimated rates indicated by a top-down royalty approach and the combined published “ask” rates for the whole of the 3GPP patents applicable to mobile devices.





# 1

## Enhanced Voice Services Background

Enhanced Voice Services (“EVS”) is a super-wideband speech/audio codec developed in 2014 and represents significant improvements to voice and music quality in mobile phones and other devices.<sup>1</sup> The codec was developed by 3GPP, the organization that develops cellular technical specifications.<sup>2</sup> 3GPP covers cellular telecommunications technologies to provide a complete system description for mobile telecommunications, including radio access, core networks, and service capabilities.<sup>3</sup>

EVS is the successor of voice codec Adaptive Multi-Rate Wideband (“AMR-WB”). Similar to other 3GPP codecs, it was developed through a collaboration between several leading companies in the industry, including manufacturers (chipset, handset, and infrastructure), operators, and technology providers.<sup>4</sup> EVS offers important new features and improvements for low-delay real-time communication systems.<sup>5</sup> Based on a novel, switched low-delay speech/audio codec, the EVS codec builds upon earlier standards from the

speech and audio coding world. It also contains various advancements for better compression efficiency and higher quality for clean/noisy speech, mixed content, and music, including support for wideband, super-wideband, and full-band content. The EVS codec operates in a broad range of bitrates, is highly robust against packet loss, and provides an AMR-WB compatible mode for compatibility with existing systems.

EVS was primarily designed for Voice over LTE (VoLTE) and fulfills all objectives defined by 3GPP in the EVS work item description, namely:<sup>6</sup>

- Enhanced quality and coding efficiency for narrowband (NB) and wideband (WB) speech services
- Enhanced quality by the introduction of super-wideband (SWB) speech
- Enhanced quality for mixed content and music in conversational applications
- Robustness to packet loss and delay jitter
- Backward compatibility to the 3GPP AMR-WB codec

1 Businesswire, “MPEG LA Introduces License for EVS”, 28th July 2018, available at: <https://www.businesswire.com/news/home/20170627006588/en/MPEG-LA-Introduces-License-for-EVS>.

2 Kari Järvinen, “Enhanced Voice Services Codec for LTE”, 3GPP, available: [https://www.3gpp.org/news-events/1639-evs\\_news](https://www.3gpp.org/news-events/1639-evs_news).

3 3GPP, “About 3GPP”, available: <https://www.3gpp.org/about-3gpp>.

4 VoiceAge.com, “EVS”, available: <http://www.voiceage.com/EVS.html>.

5 Dietz, Martin, Markus Multrus, Vaclav Eksler, Vladimir Malenovsky, Erik Norvell, Harald Pobloth, Lei Miao et al. “Overview of the EVS codec architecture.” In 2015 IEEE International Conference on Acoustics, Speech and Signal Processing [ICASSP], pp. 5698-5702. IEEE, 2015., available at: <https://ieeexplore.ieee.org/document/7179063>

6 Ibid.

Prior to EVS's standardization in 2014, AMR-WB was the dominant codec. AMR-WB was developed by Nokia and VoiceAge and first specified by 3GPP.<sup>7</sup>

At the time of its release in 2002, it was the ideal codec for wideband speech applications across converging wireline/wireless networks.<sup>8</sup>

EVS was jointly developed by the following companies, representing operators, terminal vendors, infrastructure vendors, and chipset vendors, as well as leading speech and audio coding experts:<sup>9</sup>

- Ericsson
- Fraunhofer
- Huawei
- Nokia
- NTT
- NTT DOCOMO
- Orange
- Panasonic
- Qualcomm
- Samsung
- VoiceAge
- ZTE



7 Dialogic, "Adaptive Multi-Rate Wideband (AMR-WB)", available at: <https://www.dialogic.com/glossary/adaptive-multi-rate-wideband-amr-wb>.

8 VoiceAge, "AMR-WB/G.722.2", available at: <http://www.voiceage.com/AMR-WB.G.722.2.html>.

9 Fraunhofer, "Technical Paper - Enhanced Voice Services (EVS) Codec", available at: [https://www.iis.fraunhofer.de/content/dam/iis/de/doc/ame/wp/FraunhoferIIS\\_Technical-Paper\\_EVS.pdf](https://www.iis.fraunhofer.de/content/dam/iis/de/doc/ame/wp/FraunhoferIIS_Technical-Paper_EVS.pdf).

# 2

## Fit of EVS Within the 3GPP Standards

The EVS codec is part of multiple 3GPP standards. When it was first introduced in 2014, it was an optional feature of Technical Specification (“TS”) 26.441, which is part of the 3G standard.<sup>10</sup> Since 2014, a number of different Technical Specifications support EVS across 3G, 4G, and 5G standards, illustrated below in Table 1.

The companies that developed EVS hold the vast majority (96%) of all patents declared as EVS SEPs. Stout’s team analyzed all declared SEPs and

identified 339 active patent families as declared to EVS (a total of 4,845 assets explicitly identified in EVS patent declarations, i.e., “direct declarations” to an EVS-related TS, with a total of 6,442 assets in declared families).<sup>11</sup>

Assets included in Stout’s analysis are declared to eight different TSs described below in Table 1. There are three additional TSs that cover EVS solutions, but no patents are declared to those TSs. Additionally, there is one pre-EVS release TS which is excluded.

**Table 1**  
**Overview of EVS-Related Technical Specifications<sup>12</sup>**

| TS                      | Title   | Generation |
|-------------------------|---|------------|
| TS 26.441               | Codec for Enhanced Voice Services [EVS]; General Overview                           | 3G 4G 5G   |
| TS 26.442               | Codec for Enhanced Voice Services [EVS]; ANSI C code [fixed-point]                  | 3G 4G 5G   |
| TS 26.443               | Codec for Enhanced Voice Services [EVS]; ANSI C code [floating point]               | 3G 4G      |
| TS 26.444               | Codec for Enhanced Voice Services [EVS]; Test Sequences                             | 3G 4G      |
| TS 26.445               | Codec for Enhanced Voice Services [EVS]; Detailed Algorithmic Description           | 3G 4G      |
| TS 26.446               | Codec for Enhanced Voice Services [EVS]; AMR-WB Backward Compatible Functions       | 3G 4G      |
| TS 26.447               | Codec for Enhanced Voice Services [EVS]; Error Concealment of Lost Packets          | 3G 4G      |
| TS 26.448               | Codec for Enhanced Voice Services [EVS]; Jitter Buffer Management                   | 3G 4G      |
| TS 26.449               | Codec for Enhanced Voice Services [EVS]; Comfort Noise Generation [CNG] Aspects     | 3G 4G      |
| TS 26.450               | Codec for Enhanced Voice Services [EVS]; Discontinuous Transmission [DTX]           | 3G 4G      |
| TS 26.451               | Codec for Enhanced Voice Services [EVS]; Voice Activity Detection [VAD]             | 3G 4G      |
| TS 26.114 <sup>13</sup> | IP Multimedia Subsystem [IMS]; Multimedia telephony; Media handling and interaction | 3G 4G      |

10 Synopsys, “EVS Codec for ARC Processors”, available at: [https://www.synopsys.com/dw/ipdir.php?ds=arc\\_evs\\_codec](https://www.synopsys.com/dw/ipdir.php?ds=arc_evs_codec).

11 Data as of November 2021

12 Kari Järvinen, “Enhanced Voice Services Codec for LTE”, 3GPP, available at: [https://www.3gpp.org/news-events/1639-evs\\_news](https://www.3gpp.org/news-events/1639-evs_news).

13 TS 26.114 is excluded from our analysis since it was released in 2006 (eight years before EVS was released), relates primarily to the IP Multimedia Subsystem [IMS], and captures many different technologies. After SA#66 meeting approval in December 2014, 900 assets (74 families) are declared to TS 26.114, and those assets are not declared to any other EVS-related TS

Since EVS was developed by a relatively small set of companies, only 19 companies hold EVS declared patents; the largest patent holder is Huawei, which holds 22% of the entire EVS patent share. Table 2 below illustrates the EVS SEP-declared families held by each of the 19 companies.

With respect to the overall 3GPP landscape (from 3G to 5G), Stout has identified a total of roughly 49,000 active<sup>14</sup> SEP-declared families (~230,000 active assets), of which ~10,000 families are declared

to 3G, ~25,000 to 4G, and ~40,000 to 5G.<sup>15</sup> This implies that the EVS codec, based on active family counts, accounts for only 0.7% of the total active 3GPP 3G-5G patent landscape (2.5% based on active asset count). If expired assets are also taken into consideration, the total is roughly 56,000 active and expired SEP-declared families, indicating that the EVS SEPs make up approximately 0.6% of the total active and expired 3GPP landscape (2% based on total active and expired asset count).

**Table 2**  
**EVS Landscape Overview<sup>16</sup>**

| Company                 | Declared Families |               |            |               |
|-------------------------|-------------------|---------------|------------|---------------|
|                         | Total             | Total Share % | Active     | Total Share % |
| Huawei                  | 76                | 21.7%         | 76         | 22.4%         |
| Fraunhofer-Gesellschaft | 60                | 17.1%         | 58         | 17.1%         |
| Qualcomm                | 49                | 14.0%         | 47         | 13.9%         |
| Ericsson                | 44                | 12.6%         | 42         | 12.4%         |
| Samsung                 | 27                | 7.7%          | 27         | 8.0%          |
| Orange                  | 19                | 5.4%          | 19         | 5.6%          |
| Nokia                   | 17                | 4.9%          | 15         | 4.4%          |
| VoiceAge                | 14                | 4.0%          | 14         | 4.1%          |
| Panasonic               | 11                | 3.1%          | 11         | 3.2%          |
| ETRI                    | 9                 | 2.6%          | 8          | 2.4%          |
| ZTE                     | 8                 | 2.3%          | 8          | 2.4%          |
| Crystal Clear Codec     | 6                 | 1.7%          | 6          | 1.8%          |
| Philips                 | 3                 | 0.9%          | 3          | 0.9%          |
| Oppo                    | 2                 | 0.6%          | 2          | 0.6%          |
| Deutsche Telekom        | 1                 | 0.3%          | 0          | 0.0%          |
| BlackBerry              | 1                 | 0.3%          | 1          | 0.3%          |
| Alphabet                | 1                 | 0.3%          | 0          | 0.0%          |
| NTT /NTT Docomo         | 1                 | 0.3%          | 1          | 0.3%          |
| NEC                     | 1                 | 0.3%          | 1          | 0.3%          |
| <b>Total</b>            | <b>350</b>        | <b>100.0%</b> | <b>339</b> | <b>100.0%</b> |

<sup>14</sup> At least one family member is still active

<sup>15</sup> Data as of December 2021; counts are multimode, therefore combined counts of 3G, 4G, and 5G counts exceed total since many families apply to multiple generations of the standard.

<sup>16</sup> Data as of November 2021

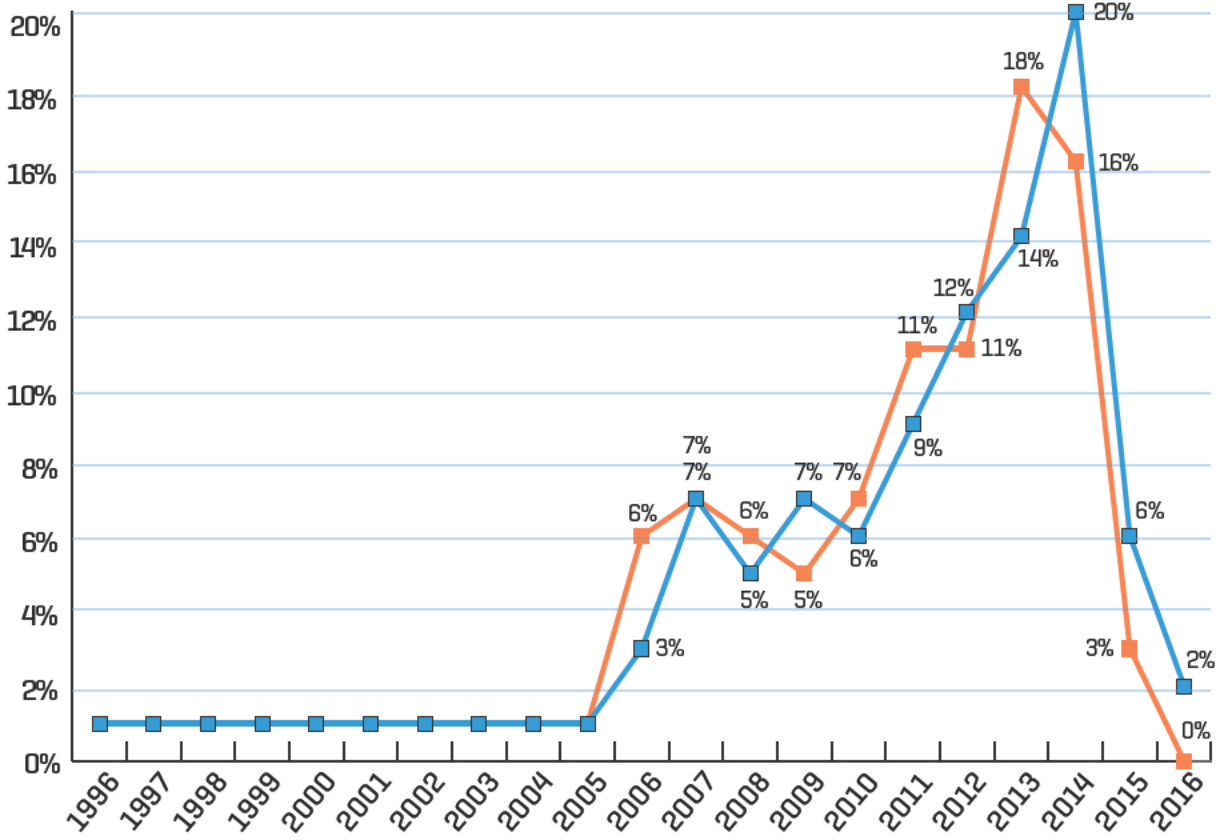


The earliest EVS declared patents claim priority back to 1996. By the end of 2014, 76% of all EVS declared patents were filed. Figure 1 below illustrates the filing timeline of EVS SEP-declared families as well as the priority date breakdown. Three percent of the declared EVS SEPs have post-2014 priority dates (i.e., after the codec was introduced to the 3GPP standard).

Figure 1

Priority and File Date Breakdown

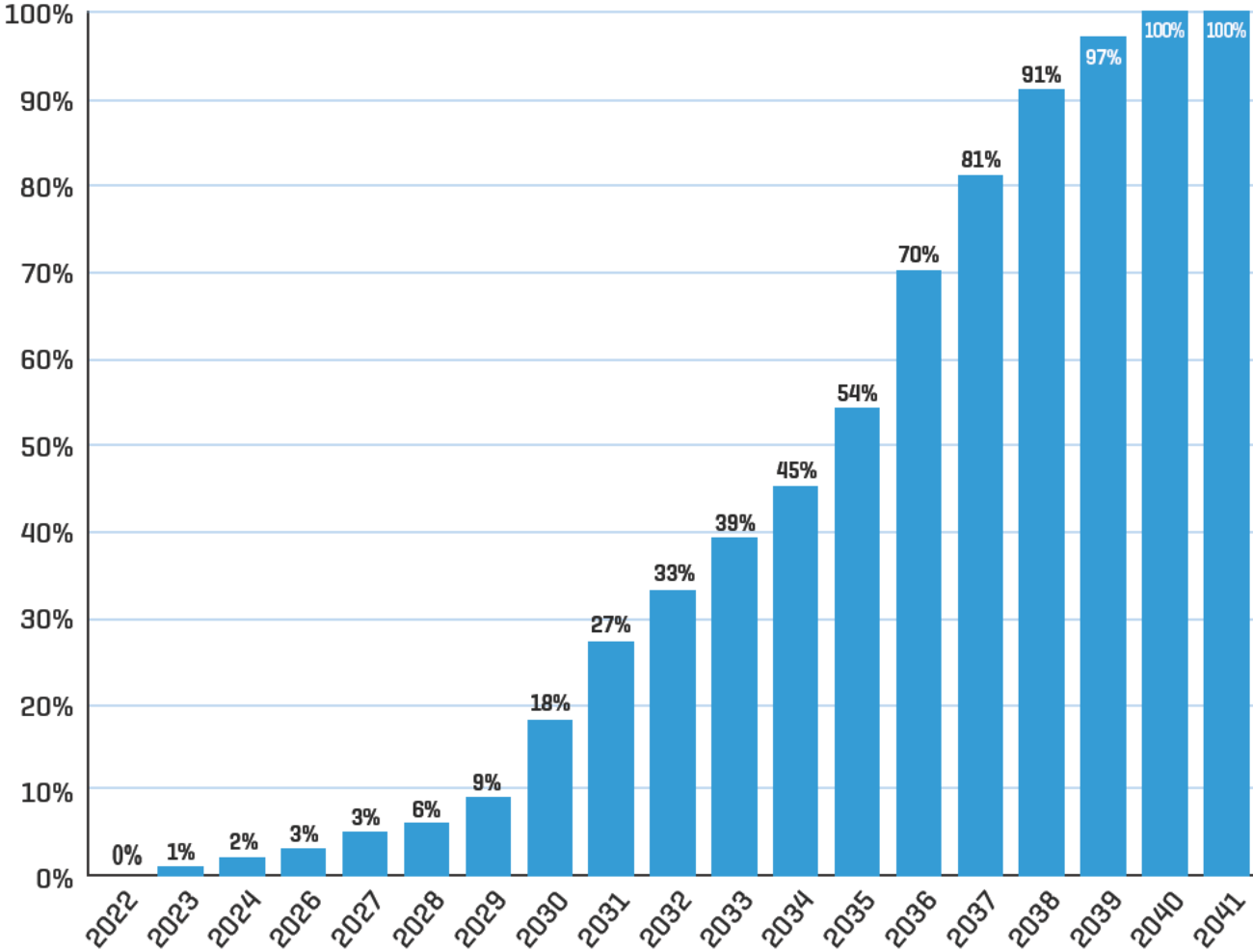
Priority Date  File Date 





Since the technology is relatively young, the majority of the declared EVS SEPs are expected to remain active well into the next decade; only one third will expire in the next 10 years – close to 50% will remain active by 2035, as illustrated in Figure 2.

**Figure 2:**  
**Expiration Date Breakdown**



# 3

## Public Patent Pools and Active Licensors

Licensors with published EVS SEP royalty rates include MPEG LA,<sup>17</sup> VoiceAge EVS LLC<sup>18</sup> (“VoiceAge”), and Crystal Clear Codec, LLC<sup>19</sup> (“Crystal Clear Codec”). These three EVS SEP licensors are offering the following royalties for use of their patented technology for mobile handsets:

**Table 3**  
**Public EVS Licensing Programs**

| Licensor            | Patent Families<br>(published counts) | Patent Families<br>(SEP Landscape) |
|---------------------|---------------------------------------|------------------------------------|
| MPEG LA             | 60 (only 42 SEPs)                     | 116                                |
| VoiceAge            | 14                                    | 14                                 |
| Crystal Clear Codec | 6                                     | 6                                  |

### MPEG LA

MPEG LA is the largest organization that licenses patents declared essential to EVS. It announced the availability of the EVS program in 2017.<sup>20</sup> The organization describes itself as “the world’s leading packager and provider of one-stop licenses for standards and other technology platforms.”<sup>21</sup> In addition to EVS, MPEG LA packages and licenses video codecs, such as H.264 and H.265, that are ubiquitous in the encoding, sharing, and decoding of streaming video around the world. The following companies in Table 4 are currently listed as licensors. Interestingly, only 42 of the 60 families are declared EVS SEPs, and some of the larger patent holders (e.g., Ericsson and Fraunhofer) have not contributed their entire EVS patent portfolios to the MPEG LA pool. This could be due to a variety of reasons, such as some remaining under evaluation or perhaps not found to be essential by the pool evaluator. The remaining 18 patent families in the MPEG LA pool are not declared to any of the 3GPP standards.

17 MPEG LA, “EVS Patent Portfolio License Program”, available at: <https://www.mpegla.com/programs/evs/>

18 VoiceAge, “VoiceAge EVS”, available at: <https://www.voiceageevs.com/>.

19 Crystal Clear Codec, “Patent Portfolio”, available at: <https://www.crystalclearcodec.com/patent-portfolio>.

20 Businesswire, “MPEG LA Introduces License for EVS”, 28th July 2018, available at: <https://www.businesswire.com/news/home/20170627006588/en/MPEG-LA-Introduces-License-for-EVS>.

21 MPEG LA, “Licenses for Standards and Other Technology Platforms”, available at: <https://www.mpegla.com/>.

Table 4

**MPEG LA EVS Pool Licensors**

| Company                 | # of Families Listed in MPEG LA EVS Pool | % of MPEG LA Pool Share | # of Declared Families Listed in MPEG LA EVS Pool | Total SEP Declared EVS Families Held by Pool Members | EVS Share % |
|-------------------------|--|-------------------------|---|--|-------------|
| Ericsson                | 26                                       | 43.3%                   | 26  | 44   | 12.6%       |
| NTT/NTT Docomo          | 17                                       | 28.3%                   | 1   | 1  | 0.3%        |
| Panasonic <sup>22</sup> | 10                                       | 16.7%                   | 9   | 11   | 3.1%        |
| Fraunhofer-Gesellschaft | 6  | 10.0%                   | 6   | 60   | 17.1%       |
| JVCKENWOOD              | 1  | 1.7%                    | 0   | 0  | 0.0%        |
| Total                   | 60                                       | 100.0%                  | 42  | 116  | 33.1%       |

**VoiceAge**

VoiceAge Corporation is also actively licensing its EVS SEPs. As mentioned above in Table 2, VoiceAge holds 14 families, which represent 4.0% of the total EVS patent share.

**Crystal Clear Codec**

Crystal Clear Codec holds the smallest portfolio of the active licensors, with only six families acquired from Huawei in 2020.<sup>23</sup> Crystal Clear Codec's portfolio represents 1.7% of the total declared EVS patent share.

**Analysis of Declared EVS SEPs**

In addition to the patent landscape, Stout examined the technical contributions to the standard.<sup>24</sup> The average approval rate of technical contributions, across all declared EVS patent holders, is 93%. This is much higher than the average approval rate for all 4G and 5G technical contributions, which is 85%, most likely due to the limited scope of EVS and smaller number of participating companies. Additional details are presented in Table 5.

Another factor when considering the overall EVS SEP patent landscape is the relevance of declared SEPs against EVS TSs. To assess the relevance, or similarity, to the EVS TSs, Stout utilized Valuenex's proprietary patent-clustering algorithm, which effectively groups a set of documents together according to their semantic similarities to one another, forming "clusters." The data used as input consisted of both the 11 EVS TSs and declared SEP US-granted patents. These clusters include a set of identified SEPs that may have a direct relation to a certain part of an EVS-related TS. Not surprisingly, the companies with the largest number of potentially relevant patents were the founding companies<sup>25</sup> (see share of similar patents in Table 5).

The Valuenex clustering largely conforms to the declared EVS patent shares; however, there are certain exceptions. For example, the clustering suggests the Fraunhofer declared patents as a whole are less relevant to the EVS standard than other patent holders.

<sup>22</sup> Some EVS related patents may have been assigned by Panasonic to Fraunhofer.

<sup>23</sup> USPTO record of assignment from Huawei to Crystal Clear Codec, available at: <https://assignment.uspto.gov/patent/index.html#/patent/search/resultFilter?advSearchFilter=patAssigneeName:%22Crystal%20Clear%20Codec%22%7CpatAssignorName:%22huawei%22&qc=2>.

<sup>24</sup> A technical contribution is a proposal submitted to the standards setting organization for inclusion in the standard.

<sup>25</sup> See list on p.7

Table 5

## Overview of Declarations, Technical Contributions, and Potential Indications of Likely Essentiality

|  | Company Breakdown       |                                   |                              |   |
|--|-------------------------|-----------------------------------|------------------------------|---|
|  | Share of Total Families | % of Approved Tech. Contributions | Share of Tech. Contributions | Share of Valuenex Similarity Analysis <sup>26</sup> |
| <b>MPEG LA Licensors (also EVS-Founding Companies)</b> |                         |                                   |                              |   |
| <i>Ericsson</i>  | 12.6%                   | 93.9%                             | 12.6%                        | 15.9%   |
| <i>Fraunhofer-Gesellschaft</i>                         | 17.1%                   | 93.9%                             | 10.5%                        | 6.8%  |
| <i>Panasonic</i>                                       | 3.1%                    | 94.1%                             | 7.9%                         | 2.3%  |
| <i>NTT</i>   | 0.3%                    | 94.4%                             | 8.4%                         | -   |
| <b>VoiceAge</b>  | 4.0%                    | 92.9%                             | 10.1%                        | 8.0%  |
| <b>Crystal Clear Codec</b>                             | 1.7%                    | 92.9%                             | 0.6%                         | 2.3%  |
| <b>EVS-Founding Companies</b>                          |                         |                                   |                              |   |
| <i>Huawei<sup>27</sup></i>                             | 21.7%                   | 94.2%                             | 7.4%                         | 17.0%   |
| <i>Nokia</i>   | 4.9%                    | 94.2%                             | 8.2%                         | 5.7%  |
| <i>Orange</i>  | 5.4%                    | 95.2%                             | 9.9%                         | 2.3%  |
| <i>Qualcomm</i>  | 14.0%                   | 93.8%                             | 8.2%                         | 12.5%   |
| <i>Samsung</i>   | 7.7%                    | 93.0%                             | 8.5%                         | 14.8%   |
| <i>ZTE</i>   | 2.3%                    | 94.1%                             | 7.9%                         | 5.7%  |
| <b>Others</b>  |                         |                                   |                              |   |
| <i>ETRI</i>  | 2.6%                    | -                                 | -                            | 1.1%  |
| <i>Philips</i>   | 0.9%                    | -                                 | -                            | 3.4%  |
| <i>OPPO</i>  | 0.6%                    | -                                 | -                            | -   |
| <i>Deutsche Telekom</i>                                | 0.3%                    | -                                 | -                            | -   |
| <i>BlackBerry</i>                                      | 0.3%                    | -                                 | -                            | 1.1%  |
| <i>Alphabet</i>  | 0.3%                    | -                                 | -                            | 1.1%  |
| <i>NEC</i>   | 0.3%                    | -                                 | -                            | -   |
| <b>Total</b>   | <b>100%</b>             | <b>94%</b>                        | <b>100%</b>                  | <b>100%</b>   |

<sup>26</sup> TS 26.445 and TS 26.447, which are the two largest EVS TSs by family counts, are included in the Valuenex analysis. These two TSs include 96.5% of the total families.

<sup>27</sup> Huawei has 186 contributions in total (175 approved). In April 2020, Crystal Clear Codec acquired six families from Huawei (out of 82 in total), hence their share of the technical contributions.

Generally, holders of patents declared essential to the 3GPP standards are required to license on a fair, reasonable, and non-discriminatory (“FRAND”) basis.<sup>28</sup> There are several methods that can be used to determine FRAND royalty terms for SEPs (whether a running royalty rate, lump-sum payment, or other terms), one of which is typically referred to as the “top-down method,” and another of which is typically referred to as a “market-based method.”

The top-down method has gained acceptance among many in the SEP licensing and valuation community, at least in part due to its reliance by the courts in both the *TCL v. Ericsson* and *Unwired Planet v. Huawei* disputes, both of which related to determining FRAND royalty terms for SEPs associated with cellular communications standards. At a high level, the implementation of the top-down method includes two primary steps:

- Estimate an aggregate royalty burden (“ARB”) for all the SEPs related to a particular standard
- Apportion the ARB to those SEPs that are the subject of the license or valuation at issue (the “Subject SEPs”) by estimating the percentage of total SEPs that are represented by the Subject SEPs

In the *TCL v. Ericsson* case, Judge James V. Selna of the Central District of California chose to utilize a range of ARBs for the 4G standard of 6%-10% of revenue for his analysis to determine a FRAND royalty rate for the 4G patents at issue in the case.<sup>29</sup> In the *Unwired Planet* case, The Honorable Mr. Justice Colin Birss in the High Court of Justice of England chose to utilize an ARB of 8.8% of revenue for 2G/3G/4G multimode handsets.<sup>30</sup> Notably, there is no similar, publicly available, court-determined ARB for 5G SEPs of which we are aware. While there are likely compelling arguments that the ARB for 5G SEPs could be higher or lower than the ARB for 4G SEPs, we also believe that an ARB for 4G SEPs ranging from 6% to 10% (based on the *TCL v. Ericsson* and *Unwired Planet* matters) is a reasonable proxy for the ARB for SEPs used in 5G multimode handsets.

As discussed earlier, declared EVS SEPs make up approximately 0.61% of the total 3GPP landscape (339 EVS SEP-declared families out of a total of roughly 56,000 active and expired 3G-5G declared SEP families). Implementing the top-down method by applying the 0.61% share of the total 3GPP patent landscape represented by EVS SEP-declared families to the estimated ARB of 6%-10% indicates a range of ARBs for EVS SEPs of 0.036%-0.061% of revenue.

<sup>28</sup> European Telecommunication and Standardization Institute - “ETSI Intellectual Property Rights Policy”, 1st December 2021, available at: <https://www.etsi.org/images/files/IPR/etsi-ipr-policy.pdf>

<sup>29</sup> *TCL Communication Technology Holdings, Ltd., et al. v. Telefonaktiebolaget LM Ericsson, et al. and Ericsson Inc., et al., v. TCL Communication Technology Holdings, Ltd., et al.*, Case No: SAVC 14-341 JVS[DFMx] Consolidated with Case No: CV 15-2370[DFMx], United States District Court, Central District of California, Memorandum of Findings of Fact and Conclusions of Law, December 17, 2017, p. 26 of 38.

<sup>30</sup> *Unwired Planet International Ltd v. Huawei Technologies Co. Ltd., et al.*, In the High Court of Justice, Chancery Division, Patents Court, Case No. HP-2014-000005, Approved Judgment, April 5, 2017, p. 96 of 166.

Although the Unwired Planet and TCL v. Ericsson cases resulted in the determination of an ARB articulated as a percentage of revenue, it is not uncommon for SEPs to be licensed using a royalty rate articulated as a dollar per unit. Based on mobile handset market data from IDC, the estimated average wholesale price of a 5G mobile handset during the period 2019-2024 is estimated to be approximately \$410.54.<sup>31</sup> Applying the estimated EVS ARB of 0.036%-0.061% produced from the implementation of the top-down approach to this average mobile handset price indicates a dollar per unit FRAND royalty rate of approximately \$0.15-\$0.25. This range of ARBs indicates a per-family royalty rate ranging from \$0.0004 to \$0.0007 per unit.

Notably, the implementation of the top-down approach, consistent with how the method was implemented in Unwired Planet and TCL v. Ericsson, implies that each SEP family is equally valuable. As such, the \$0.0004 to \$0.0007 per-family royalty rate range related to EVS SEPs also represents an estimated royalty rate associated with other 3GPP SEPs.

Use of the market-based method for determining FRAND royalty terms for SEPs is based upon traditional valuation theory. The International Glossary of Business Valuation Terms defines the market (market-based) approach as “a general way of determining a value indication of a business, business ownership interest, security, or intangible asset by using one or more methods that compare the subject to similar businesses, business ownership interests, securities, or intangible assets that have been sold.”

In one implementation of the market-based method to determine FRAND royalty terms for EVS SEPs, one may seek out and identify known royalty terms for EVS SEPs and use those terms to indicate the value of the EVS SEPs one wishes to license or value. We are currently aware of three sources of EVS SEP royalty rates, which are being offered by VoiceAge, Crystal Clear, and MPEG LA. These three EVS SEP licensors are offering the following royalties for use of its patented technology for mobile handsets:

|                                   | <b>EVS Royalty Rates</b>      | <b>EVS Patent Families</b> | <b>Royalty Rates Per Family</b> |
|-----------------------------------|-------------------------------|----------------------------|---------------------------------|
| <b>Voice Age<sup>32</sup></b>     | \$0.22-\$0.40                 | 14                         | \$0.016-\$0.029                 |
| <b>Crystal Clear<sup>33</sup></b> | \$0.29-\$0.44                 | 6                          | \$0.048-\$0.073                 |
| <b>MPEG LA<sup>34</sup></b>       | \$0.40 <sup>35</sup> - \$0.70 | 116 <sup>36</sup>          | \$0.003-\$0.006                 |
| <b>Total</b>                      | \$0.91-\$1.54                 | 136                        | \$0.007-\$0.011                 |

31 IDC provides 5G mobile handset revenue data on a retail basis. For purposes of estimating average wholesale prices, we reduced IDC-based retail price data to account for an estimated retail mark-up of 25%.

32 VoiceAge EVS, “Rate Summary”, Category 6 - Handsets and WiFi Devices, available at: <https://voiceageevs.com/rate.aspx>.

33 Crystal Clear Codec, “Licensing”, available at: <https://www.crystalclearcodec.com/licensing>.

34 See <https://www.mpegla.com/wp-content/uploads/EVSWeb.pdf>.

35 Although MPEG LA offers a \$0.00 per unit royalty rate for sales of between 0 and 50,000 units in any given year, we chose to use a \$0.40 per unit royalty rate as a lower bound for our analysis given the immateriality of the \$0.00 per unit royalty for such a low volume of unit sales.

36 The MPEG LA pool lists 60 patent families as covered by the EVS license (only 42 of which are declared as essential to the 3GPP standard), but conservatively using 116 patent families per SEP landscape since “Licensors agree to include all EVS Essential Patents.” See the MPEG LA EVS “Patent List” web page at <https://www.mpegla.com/programs/evs/patent-list/>.

The range of royalty rates per family across all three licensors of approximately \$0.007-\$0.011 indicates an ARB for all 339 EVS SEP families ranging from approximately \$2.27 to \$3.84.

Importantly, the ARBs and royalty rates per family calculated above may not necessarily be consistent with FRAND royalty terms for EVS SEPs. For one, our market-based method is based on published “ask” rates that may or may not be consistent with actual royalty rates agreed to by EVS SEP licensors and licensees. From our experience, it is not uncommon that licensor-published “ask” rates are a starting point for negotiating actual rates with licensees, which may end up being lower than the published “ask” rates. With that said, we are aware of instances when “ask” rates are equal to the rates agreed to by licensees. Second, there may be other relevant data points and methods that we have not considered in our implementation of the top-down method and market-based method that may be relevant to determine FRAND royalty

terms for EVS SEPs. For example, FRAND royalty terms for specific EVS SEPs may be affected by issues such as the number of SEP families being licensed, the geographical coverage of the relevant SEPs, the geographies in which the licensee is seeking a license, and potentially others. As such, the analyses that produced the estimated ARBs and royalty rates per family described above are only illustrative and may or may not represent royalties that we would conclude upon if we were asked to perform a more in-depth, rigorous FRAND royalty term analysis for an actual business purpose such as a licensing transaction/negotiation, patent pool formation, litigation, etc.

To test the reasonableness of our EVS SEP royalty rate estimates described above, we have compared them to published “ask” rates associated with other 5G SEPs. We are currently aware of four sources of 5G SEP royalty rates being offered by Ericsson, Nokia, InterDigital, and Huawei. These four 5G SEP holders are offering licenses at the following royalties for mobile handsets:

|                     | 5G SEP Royalty Rates <sup>37, 38</sup> | Royalty Rates Per Family <sup>39</sup> |
|---------------------|--|--|
| <b>Ericsson</b>     | \$2.50-\$5.00                          | \$0.0008-\$0.0016                      |
| <b>Nokia</b>        | \$3.41 <sup>40</sup>                   | \$0.0008                               |
| <b>InterDigital</b> | \$1.20 <sup>41</sup>                   | \$0.0009                               |
| <b>Huawei</b>       | \$2.50 <sup>42</sup>                   | \$0.0004                               |
| <b>Total</b>        | \$9.61-\$12.11                         | \$0.0006-\$0.0008                      |

37 5G SEP rates are related to multimode handsets.

38 For Ericsson’s, Nokia’s, and InterDigital’s published “ask” rates, see “Royalty Rates And Licensing Strategies For Essential Patents on 5G Telecommunication Standards: What to Expect,” Eric Stasik and David L. Cohen, *les Nouvelles*, September 2020. For Huawei’s published “ask” rates, see “Huawei to start charging royalties to smartphone makers using its patented 5G tech,” Arjun Kharpal, March 16, 2021 [<https://www.cnbc.com/2021/03/16/huawei-to-charge-royalties-to-smartphone-makers-using-its-5g-tech-.html>].

39 5G multimode SEP families are based on Stout’s proprietary 5G SEP patent landscape.

40 Nokia’s published rate is EUR 3.00, which has been converted to U.S. dollars.

41 InterDigital’s published rate is 0.6% of the price of the relevant product with a price cap of \$200. As such, the royalty rate as a dollar per unit of \$1.20 was calculated as 0.6% multiplied by \$200.

42 \$2.50 per unit represents Huawei’s royalty rate cap [see <https://www.huawei.com/en/news/2021/3/huawei-releases-whitepaper-innovation-intellectual-property-2020>].

Comparing our EVS SEP royalty rate per family estimates to the same metric for all 5G SEPs owned by Ericsson, Nokia, InterDigital, and Huawei, combined, based on the above public “ask” rates, produces the following:

|   | Royalty Rates Per Family |
|---|--------------------------|
| <b>EVS SEPs – Top-Down Method</b>                                 | \$0.0004-\$0.0007        |
| <b>EVS SEPs – Market-Based Method</b>                             | \$0.0067-\$0.0113        |
| <b>5G SEPs Owned by Ericsson, Nokia, InterDigital, and Huawei</b> | \$0.0006-\$0.0008        |

Per the table above, average published “ask” rates for EVS SEPs being licensed by VoiceAge, Crystal Clear, and MPEG LA (as indicated by the market-based method) are approximately 11-15 times higher than the estimated rates indicated by the top-down method for EVS SEPs and the combined published “ask” rates for 5G SEPs owned by Ericsson, Nokia, InterDigital, and Huawei.

**CONCLUSION**

EVS SEP “ask” rates do not appear to be consistent with the share of EVS SEPs out of the total 3G-5G SEP landscape. EVS SEP “ask” rates are approximately 11-15 times higher than the per-unit rates indicated by a rough implementation of the top-down method and “ask” rates for other non-EVS 5G SEPs. This significant difference in rates raises the question of whether the EVS “ask” rates presented by VoiceAge, Crystal Clear, and MPEG LA can be viewed as FRAND.<sup>43</sup> If other subgroups of technologies within the 3GPP standard follow the same licensing strategy as EVS, with separate pools and licensing programs, the total aggregate royalty burden for 5G will rapidly exceed the estimate of 6%-10% of the wholesale price of a smartphone.

<sup>43</sup> However, we do not express any opinion as to the reasonableness of any of the discussed “ask” rates or of comparing rates for an audio codec to a wireless telecommunications standard.

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